

Elementare Differentialgeometrie

Übungsblatt 5

Aufgabe 1.

- (a) Sei M eine Fläche und H eine Ebene im \mathbb{R}^3 , die M in einer Kurve γ schneidet. Zeigen Sie, daß γ eine Geodätische ist, falls H eine Symmetrieebene von M ist.
- (b) Jede Gerade auf einer Fläche ist eine Geodätische.
- (c) Sei M die Fläche $\{x^2 + y^2 - z^2 = 1\}$. Finden Sie möglichst viele Geodätische auf M .

Aufgabe 2. Man bilde den Durchschnitt des Zylinders $\{x^2 + y^2 = 1\}$ im \mathbb{R}^3 mit einer Ebene, die die x -Achse enthält und einen Winkel θ mit der xy -Ebene bildet.

- (a) Zeigen Sie, daß die Schnittkurve γ eine Ellipse ist.
- (b) Berechnen Sie die geodätische Krümmung und die Normalkrümmung von γ , aufgefaßt als Kurve im Zylinder, in den Punkten, in denen die Ellipse ihre Achsen schneidet.

Aufgabe 3.

- (a) Die Matrix (L_{ij}) , die die zweite Fundamentalförm beschreibt, ist für eine Rotationsfläche wie in Aufgabe 1 vom Übungsblatt 4 gegeben durch

$$\frac{1}{\sqrt{r^2 + z^2}} \begin{pmatrix} rz - zr & 0 \\ 0 & rz \end{pmatrix}.$$

- (b) Es gilt $\det(L_{ij}) = 0$ genau dann, wenn jeder Meridian eine Gerade ist.

Aufgabe 4. Betrachten Sie ein Flächenstück von der Form

$$\kappa(u^1, u^2) = (u^1, u^2, f(u^1, u^2)),$$

d.h. einen Graphen. Berechnen Sie die erste und die zweite Fundamentalförm (g_{ij}) , (L_{ij}) . Bestimmen Sie das Christoffel-Symbol Γ_{ij}^k sowohl extrinsisch (d.h. mittels der ursprünglichen Definition) als auch intrinsisch (d.h. mittels Satz 3.5).

Elementare Differentialgeometrie

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Silva Neto**



Elementare Differentialgeometrie:

Elementare Differentialgeometrie Christian Bär, 2024-05-06 Die dritte Auflage des bewährten Lehrbuchs bietet vollständig bearbeitet und aktualisiert eine fundierte und zugängliche Einführung in die Differentialgeometrie von Kurven und Flächen. Beginnend mit klassischer euklidischer Geometrie deckt das Lehrbuch wichtige Themen wie Kurven und Flächentheorie, die zentrale Bedeutung der Krümmung sowie analytische und topologische Aspekte ab. Auch Minimalflächen, hyperbolische Geometrie, Anwendungen in der Kartografie und der Satz von Gauß-Bonnet werden behandelt. Die mathematische Darstellung ist so gewohnt, dass sich das Buch als Einstieg in die abstrakte Riemannsche Geometrie eignet. Eine der wichtigsten Erweiterungen in dieser Auflage ist die verbesserte Darstellung der Konstruktion von Triangulierungen. Durch Illustrationen und verständlichere Erklärungen wird nun ein noch tieferes und intuitiveres Verständnis der Materie ermöglicht. Zu jedem Kapitel finden sich sorgfältig ausgewählte Übungsaufgaben, die das Gelernte vertiefen und anwenden lassen. Die meisten Aufgaben sind mit ausführlichen Lösungshinweisen versehen, die helfen, die Konzepte selbstständig zu meistern und das Wissen zu festigen.

Elementare Differentialgeometrie W. Haack, 1980-01-01 **A Course in Differential Geometry** W. Klingenberg, 2013-03-14 This English edition could serve as a text for a first year graduate course on differential geometry as it did for a long time the Chicago Notes of Chern mentioned in the Preface to the German Edition. Suitable references for ordinary differential equations are Hurewicz, W. Lectures on ordinary differential equations, MIT Press, Cambridge, Mass. 1958 and for the topology of surfaces Massey, Algebraic Topology, Springer Verlag, New York, 1977. Upon David Hoffman fell the difficult task of transforming the tightly constructed German text into one which would mesh well with the more relaxed format of the Graduate Texts in Mathematics series. There are some elaborations and several new figures have been added. I trust that the merits of the German edition have survived, whereas at the same time the efforts of David helped to elucidate the general conception of the Course where we tried to put Geometry before Formalism without giving up mathematical rigour. I wish to thank David for his work and his enthusiasm during the whole period of our collaboration. At the same time I would like to commend the editors of Springer Verlag for their patience and good advice. Bonn, Wilhelm Klingenberg, June 1977. vii. From the Preface to the German Edition. This book has its origins in a one semester course in differential geometry which I have given many times at Göttingen, Mainz and Bonn.

Elementary Differential Geometry Christian Bär, 2010-05-06 The link between the physical world and its visualization is geometry. This easy to read, generously illustrated textbook presents an elementary introduction to differential geometry with emphasis on geometric results. Avoiding formalism as much as possible, the author harnesses basic mathematical skills in analysis and linear algebra to solve interesting geometric problems which prepare students for more advanced study in mathematics and other scientific fields such as physics and computer science. The wide range of topics includes curve theory, a detailed study of surfaces, curvature, variation of area and minimal surfaces, geodesics, spherical and hyperbolic geometry, the divergence theorem, triangulations and the Gauss-Bonnet theorem. The

section on cartography demonstrates the concrete importance of elementary differential geometry in applications. Clearly developed arguments and proofs, colour illustrations and over 100 exercises and solutions make this book ideal for courses and self study. The only prerequisites are one year of undergraduate calculus and linear algebra.

Tensor Analysis and Elementary Differential Geometry for Physicists and Engineers Hung Nguyen-Schäfer, Jan-Philip Schmidt, 2016-08-16

This book presents tensors and differential geometry in a comprehensive and approachable manner providing a bridge from the place where physics and engineering mathematics end and the place where tensor analysis begins. Among the topics examined are tensor analysis, elementary differential geometry of moving surfaces and k differential forms. The book includes numerous examples with solutions and concrete calculations which guide readers through these complex topics step by step. Mindful of the practical needs of engineers and physicists, the book favors simplicity over a more rigorous formal approach. The book shows readers how to work with tensors and differential geometry and how to apply them to modeling the physical and engineering world. The authors provide chapter length treatment of topics at the intersection of advanced mathematics and physics and engineering: General Basis and Bra Ket Notation, Tensor Analysis, Elementary Differential Geometry, Differential Forms, Applications of Tensors and Differential Geometry, Tensors and Bra Ket Notation in Quantum Mechanics. The text reviews methods and applications in computational fluid dynamics, continuum mechanics, electrodynamics in special relativity, cosmology in the Minkowski four dimensional space time and relativistic and non relativistic quantum mechanics. *Tensor Analysis and Elementary Differential Geometry for Physicists and Engineers* benefits research scientists and practicing engineers in a variety of fields who use tensor analysis and differential geometry in the context of applied physics and electrical and mechanical engineering. It will also interest graduate students in applied physics and engineering.

Differential Geometry Victor V. Prasolov, 2022-02-10. This book combines the classical and contemporary approaches to differential geometry. An introduction to the Riemannian geometry of manifolds is preceded by a detailed discussion of properties of curves and surfaces. The chapter on the differential geometry of plane curves considers local and global properties of curves, evolutes and involutes and affine and projective differential geometry. Various approaches to Gaussian curvature for surfaces are discussed. The curvature tensor, conjugate points and the Laplace Beltrami operator are first considered in detail for two dimensional surfaces which facilitates studying them in the many dimensional case. A separate chapter is devoted to the differential geometry of Lie groups.

Differential Geometry of Curves and Surfaces Victor Andreevich Toponogov, 2006-09-10. This concise guide to the differential geometry of curves and surfaces can be recommended to first year graduate students, strong senior students and students specializing in geometry. The material is given in two parallel streams. The first stream contains the standard theoretical material on differential geometry of curves and surfaces. It contains a small number of exercises and simple problems of a local nature. It includes the whole of Chapter 1 except for the problems, Sections 1.5, 1.7, 1.10 and Section 1.11 about the phase length of a curve and the whole of Chapter 2.

except for Section 2.6 about classes of surfaces Theorems 2.8.1, 2.8.4, the problems Sections 2.7.4, 2.8.3 and the appendix Section 2.9. The second stream contains more difficult and additional material and formulations of some complicated but important theorems for example a proof of A.D. Aleksandrov's comparison theorem about the angles of a triangle on a convex surface, formulations of A.V. Pogorelov's theorem about rigidity of convex surfaces and S.N. Bernstein's theorem about saddle surfaces. In the last case the formulations are discussed in detail. A distinctive feature of the book is a large collection (80 to 90) of nonstandard and original problems that introduce the student into the real world of geometry.

Global Differential Geometry and Global Analysis D. Ferus, W. Kühnel, U. Simon, B. Wegner, 2006-11-15

Differential Geometry of Plane Curves Hilário Alencar, Walcy Santos, Gregório Silva Neto, 2022-04-27 This book features plane curves the simplest objects in differential geometry to illustrate many deep and inspiring results in the field in an elementary and accessible way. After an introduction to the basic properties of plane curves the authors introduce a number of complex and beautiful topics including the rotation number with a proof of the fundamental theorem of algebra, rotation index, Jordan curve theorem, isoperimetric inequality, convex curves, curves of constant width and the four vertex theorem. The last chapter connects the classical with the modern by giving an introduction to the curve shortening flow that is based on original articles but requires a minimum of previous knowledge. Over 200 figures and more than 100 exercises illustrate the beauty of plane curves and test the reader's skills. Prerequisites are courses in standard one variable calculus and analytic geometry on the plane.

Handbook of Convex Geometry Bozzano G. Luisa, 2014-06-28 Handbook of Convex Geometry Volume A offers a survey of convex geometry and its many ramifications and relations with other areas of mathematics including convexity, geometric inequalities and convex sets. The selection first offers information on the history of convexity, characterizations of convex sets and mixed volumes. Topics include elementary convexity, equality in the Aleksandrov-Fenchel inequality, mixed surface area measures, characteristic properties of convex sets in analysis and differential geometry and extensions of the notion of a convex set. The text then reviews the standard isoperimetric theorem and stability of geometric inequalities. The manuscript takes a look at selected affine isoperimetric inequalities, extremum problems for convex discs and polyhedra and rigidity. Discussions focus on include infinitesimal and static rigidity related to surfaces, isoperimetric problem for convex polyhedral bounds for the volume of a convex polyhedron, curvature image inequality, Busemann intersection inequality and its relatives and Petty projection inequality. The book then tackles geometric algorithms, convexity and discrete optimization, mathematical programming and convex geometry and the combinatorial aspects of convex polytopes. The selection is a valuable source of data for mathematicians and researchers interested in convex geometry.

Foundations of Potential Theory Oliver Dimon Kellogg, 1929

Minimal Surfaces I Ulrich Dierkes, Stefan Hildebrandt, Albrecht Küster, Ortwin Wohlrab, 2013-11-27 Minimal surfaces I is an introduction to the field of minimal surfaces and a presentation of the classical theory as well as of parts of the modern development centered around boundary value problems. Part II deals with the boundary behaviour of minimal

surfaces Part I is particularly apt for students who want to enter this interesting area of analysis and differential geometry which during the last 25 years of mathematical research has been very active and productive Surveys of various subareas will lead the student to the current frontiers of knowledge and can also be useful to the researcher The lecturer can easily base courses of one or two semesters on differential geometry on Vol 1 as many topics are worked out in great detail Numerous computer generated illustrations of old and new minimal surfaces are included to support intuition and imagination Part 2 leads the reader up to the regularity theory for nonlinear elliptic boundary value problems illustrated by a particular and fascinating topic There is no comparably comprehensive treatment of the problem of boundary regularity of minimal surfaces available in book form This long awaited book is a timely and welcome addition to the mathematical literature

Foundations of Differential Geodesy Joseph Zund, 2012-12-06 Differential geodesy is concerned with the geometry of the gravity field of the Earth which is of fundamental importance to both theoretical geodesy and geophysics This monograph presents a unified treatment of the foundations of differential geodesy as proposed originally by Antonio Marussi and Martin Hotine in their work The principal features of the Marussi Hotine approach to theoretical aspects are given in the first five chapters based on leg calculus while the last five chapters are devoted to the fundamental ideas of the Marussi and Hotine theory The text includes practical problems and is intended for use by research geodesists graduate students in geodesy and theoretical geophysicists

Calculus of Variations I Mariano Giaquinta, Stefan Hildebrandt, 2004-06-23 This two volume treatise is a standard reference in the field It pays special attention to the historical aspects and the origins partly in applied problems such as those of geometric optics of parts of the theory It contains an introduction to each chapter section and subsection and an overview of the relevant literature in the footnotes and bibliography It also includes an index of the examples used throughout the book

Introduction of Advanced State Space Grids and Their Application to the Analysis of Physics Teaching Niklas Litzenberger, 2023-10-25 Teaching is characterized by complex interactions Therefore it is difficult to make global statements about a teaching sequence However methods that aim at a global assessment of teaching have often been used in indicator based lesson observation It remains unclear how reliable global assessments of entire lesson sequences are since no statements can be made about dynamic processes taking place One approach is the State Space Grids SSG developed by Hollenstein 2013 These make it possible to relate the development of two teaching characteristics to each other over time to visualize dynamic processes However there is no suitable way to numerically capture the relationship between indicators e g to compare such moment to moment assessments with global assessments The aim of this work is therefore to extend the SSG approach to Advanced State Space Grids with mathematically based parameters to test their practicability to compare them with global assessments of entire teaching sequences and to investigate their applicability to physics teaching Numerical and graphical elements are added to the SSG plot These include new relation types between the recorded indicators chi square tests and parameters for densities and deviations

Pattern

Recognition Gerhard Rigoll, 2008-06-29 This book constitutes the refereed proceedings of the 30th Symposium of the German Association for Pattern Recognition DAGM 2008 held in Munich Germany in June 2008 The 53 revised full papers were carefully reviewed and selected from 136 submissions The papers are organized in topical sections on learning and classification tracking medical image processing and segmentation audio speech and handwriting recognition multiview geometry and 3D reconstruction motion and matching and image analysis Proceedings of the European Computing Conference Nikos Mastorakis, Valeri Mladenov, Vassiliki T. Kontargyri, 2010-03-16 The European Computing Conference offers a unique forum for establishing new collaborations within present or upcoming research projects exchanging useful ideas presenting recent research results participating in discussions and establishing new academic collaborations linking university with the industry Engineers and Scientists working on various areas of Systems Theory Applied Mathematics Simulation Numerical and Computational Methods and Parallel Computing present the latest findings advances and current trends on a wide range of topics This proceedings volume will be of interest to students researchers and practicing engineers

Geometric Applications of Fourier Series and Spherical Harmonics H. Groemer, 1996-09-13 This book provides a comprehensive presentation of geometric results primarily from the theory of convex sets that have been proved by the use of Fourier series or spherical harmonics An important feature of the book is that all necessary tools from the classical theory of spherical harmonics are presented with full proofs These tools are used to prove geometric inequalities stability results uniqueness results for projections and intersections by hyperplanes or half spaces and characterisations of rotors in convex polytopes Again full proofs are given To make the treatment as self contained as possible the book begins with background material in analysis and the geometry of convex sets This treatise will be welcomed both as an introduction to the subject and as a reference book for pure and applied mathematics **Bibliographie de la Relativité** Maurice Lecat, Mme. M. Lecat-Pierlot, 1924 Differential Geometrical Methods in Mathematical Physics K. Bleuler, A. Reetz, 2006-11-15

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